RSVP Project Director's Report
for September 2004

W.J. Willis, RSVP Project Manager
J. Kotcher, RSVP Deputy Project Manager

[1] RSVP Project Office (WBS 1.1)

Work continued throughout September on setting up three comprehensive reviews of critical aspects of RSVP. Currently these three major reviews are scheduled as follows:

(a) MECO Superconducting Magnet: Columbia University, 10-12 October 2004.
(b) AGS Upgrade Project and AGS Operations for RSVP: Brookhaven National Laboratory, 4-5 November 2004.
(c) RSVP Simulations – Detector Design and Capability (KOPIO and MECO): New York University, 11-13 January 2005.

Preparation for these reviews includes determining the charge to the committee, the agenda for the review, and obtaining commitments to serve from the desired review committee members. These are determined via extensive consultations with the experimenters, the funding agencies, and independent experts in the field.

Other important RSVP Project Office activities during September included finalizing the full RSVP timeline through May 2005. This timeline includes a list of all relevant reviews and other project milestones, chosen with an eye toward maximizing project readiness prior to submission of the comprehensive project status report to NSF in May. It was discussed extensively with the experimenters and the NSF Program Manager, and provides the goals for all work pursued during the coming months. The goal is to review and flesh out as fully as possible all aspects of the RSVP project and scientific/technical program prior to this May date.

The appropriate requests for supplementary funding from the NSF for FY 2005 were also developed during this month. In addition, weekly meetings between the Deputy Project Director and the Project Managers for KOPIO, MECO, and the AGS were scheduled. Discussions include the development of resource-loaded schedules, technical issues, personnel needs and concerns, budgetary issues, and other project-related topics. Further headway was also made toward setting up Project Offices at both Columbia University and Brookhaven.

Detailed discussions of the September activities for the three major sub-projects follow below.

[2] KOPIO Experiment (WBS 1.2)

AGS Mods for September 2004 (formerly WBS 2.1).

Mike Sivertz has returned to the simulation effort for studying the interbunch extinction expected for KOPIO using the computer cluster at the AGS. This should give improved results this year. Additional progress was made in analysis of the May test beam data. The final report should be out soon.

1.2.1 Vacuum Subsystem: Ralph L. Brown

We have updated the agreement with KOMPOZIT to reflect the possibility of a vendor visit during the testing phase of the prototype vessels. Working on resource loaded schedule for the subsystem.

1.2.2 Preradiator system: Toshio Numao

Full length chamber prototypes IIIa (anode) and IIIc are used for the test of front-end anode and cathode electronics. Data taking for the study of large-angle cathode resolution is in progress. Analysis programs have been written and are being debugged. Materials for full-scale chamber prototypes have been tested, and will be ordered shortly. Scintillator production for equivalent of one full plane was successful; one surface was flat and the other was almost good enough to eliminate surface machining. One more iteration is planned to improve the straightness and hole quality before full module production runs (9 planes). Three scintillator bars were laminated side-by-side and surface-machined. The sheet is tested for timing, light yield, and light transmission between the joints.

1.2.3 Calorimeter Vladimir Issakov

Last month, group activity included:

- Development of the Monte-Carlo study of the Calorimeter module response to photon detection, to specify the parameters of the APD readout electronics and Wave Form Digitizers. That includes simulation of the WFD signal, taking into account the decay times and the light propagations in scintillators and WLS fibers, APD/preamplifier response, the signal propagation in cable, the electronic noises and a signal digitizing in WFD module.
- Development of programs of photon and neutron signal recognition in the Calorimeter, to study clump recognition and detection efficiency.
- Development of analysis of the rate in Calorimeter due to noise and a neutron background.
- Development of a new fast voltage preamplifier for APD readout, to improve the rate characteristic of the APD photo-readout chain. Analysis of the trigger specification for the WFD, to understand the issues for Calorimeter usage in a fast low-level trigger.
- Development of a cost and schedule analysis for the design and production of the Calorimeter System

1.2.4 Charged Particle Veto A. vanderSchaaf

(1) r&d

Activities in Zurich included:

- some rudimentary discussions about testing Geigermode APD's.
- Since available beam time at PSI shifted back in time (making it hard for us to accomodate) and since there were no issues of study requiring beam (other than measuring the missing data point for CPV inefficiency at 500 MeV/c) we decided not to take beam this year.
- We did take data which should allow us to check the effect of a dead layer of order g/cm2 on photon inefficiency (not really our responsibility) but the analysis may take a some time. Signals from the coating front are disappointing in the sense that the company seems not really interested and thus asks too much. We will have to look for alternatives.

Otherwise some hardware arrived (PMT's in particular).

(2) project preparation

- we updated action items
- we made a first try at WBS costing, dictionary has yet to be done.

1.2.5 Photon Barrel Veto: Oleg Mineev

1. Scintillator samples manufactured at Vladimir and IHEP were tested to compare their quality with WLS fiber readout. Both samples were produced by molding of polystyrene based scintillator with different dopant composition. IHEP sample shows about 15% higher light yield.
2. The shashlyk modules manufactured at Vladimir and IHEP of different segmentation were tested with cosmic rays. Vladimir modules have 68 layers of 2mmPb/4mmSci, one is readout with Y11 fibers of 1.1 mm diameter spaced at 10.1 mm, another module with fibers spaced at 15 mm. The first one shows almost 20% higher light yield.

IHEP module is made of 300 layers of 0.28mmPb/1.5mmSci., Y11 fibers of 1 mm diameter spaced at 9.3 mm. Vladimir and IHEP modules differ by the ccintillator type, segmentation and reflector.

1.2.6 Catcher: N.Sasao

(1) Monte Carlo simulation program is being set up to study performance of the catcher. In particular, the background photon energy spectrum entering the guard counter, a counter surrounding the catcher’s main part, is studied.

(2) Properties of aerogel, the Cherenkov radiator material used in the catcher’s main part, are investigated. In particular, absorption and scattering properties are experimentally determined using LEDs.

(3) A laboratory setup for measuring aerogel photon yield is being built. This setup is composed of a pair of solenoid magnets, which focus isotope electrons on an aerogel sample, and Cherenkov photon measuring counters.

1.2.7 Trigger: Aniello Nappi

Not much progress has been achieved in simulation studies. A list of setup cuts for future efficiency estimates has been agreed on. A MC study of a trigger algorithm for photon counting in the preradiator+calorimeter based on logic signals from x and y strips has been initiated. We still fall short of a reliable estimate of rates and efficiencies based on a simulation including all known sources of accidental activity and using the agreed setup cuts.

To lay the ground for cost estimates, we are trying to better define the specifications for some key elements of a level 1 trigger, as described (in its broad functionalities) in the WBS presented to the technical board in June. We have discussed possible options for:
(a) a charge/time digitizer dedicated to the trigger and providing redundancy for the main WFD readout system;
(b) a standard of intercommunication between different trigger stages;
(c) the clock system.

While point (a) requires further understanding (separate function ADC/TDC? analog integration for charge measurement? sampling frequency for charge measurement?) based on detailed rate simulations, clear preferences emerged for points (b) and (c). For (b) a solution based on serial links with ~200Mb/s speed, carrying zero suppressed data, appears feasible, but its implications on trigger dead time and latency need to be studied by simulations, after a better definition of the resynchronization algorithms. For (c) a 25MHz clock synchronous with the extraction RF, backed up by a constant frequency clock during setup periods, looks adequate for all readout and trigger systems. Progress is slow due to lack in manpower for simulation studies and engineering support for detailed discussions of technical options.

1.2.8 DAQ/L3 work: George Redlinger

Cost/schedule estimates for the DAQ/L3 system are mostly complete.
The groundwork was laid to start discussions with BNL Instrumentation for a collaboration on DAQ/Trigger hardware R&D.
Simple tests of data transfer speed via 4x Infiniband were made and compared to rates through gigabit ethernet. Software provided by Mellanox indicated performance consistent with expectations (close to 10 Gbit/second). Tests of Infiniband with our own software showed much poorer performance (our own software was first checked to work properly with gigabit ethernet). The differences are being investigated.

1.2.9 Off-Line Computing: R Poutissou

In September, I have attended the conference CHEP04 – Computing in High Energy Physics to acquaint myself with the latest techniques used in the field.
In October, I will be looking for volunteers to help craft a first draft of the WBS, costs and schedules for this sub-system.

Simulations: D.Jaffe
KOPIO GEANT MC improvements: More KL decay modes, better matrix elements. Matrix elements were corrected for muon decays.

FastMC improvements: Better veto modeling, including calculated uncertainties on reconstructed kinematic quantities in analysis ntuple.

1.2.10 Detector Systems: Ralph L. Brown
Presently working on preparing a resource loaded schedule for this subsystem. Continued discussion with regard to subsystem installation scenarios and updating experiment integration drawings.

1.2.11 Project Services M. Marx
The Project Office has been occupied with developing a fully resource loaded schedule. Work has progressed on getting MoU/SoW's executed with BNL for Physics and C-A activities, Yale and TRIUMF. FY04 funds arrived at Stony Brook on September 20.
Hardware and software are being procured to aid project development. Personnel are being recruited to assist with the engineering development of KOPIO.

J. Comfort, Arizona State University

For the past several months, we have been developing Monte Carlo simulations of the response of the scintillators in the preradiator to incident e+ or e- particles. A GEANT4 code has been assembled. A 125-MeV electron passing through a 2m x 2m x 9mm scintillator loses energy and produces optical photons. The photons are individually tracked through the scintillator to wave-length-shifting fibers, which then transmit photons to phototubes at the ends. About 0.8% of the generated optical photons reach a phototube. The physical properties of the scintillators, coatings on the surface, and fibers have been carefully specified. Wave forms have been generated from the photons by including the response functions of the phototubes. A fast subroutine, parameterizing the results of the study, will be made available for the full Monte Carlo code.

Stony Brook Activity – Michael Marx
Stony Brook personnel contributed in a wide range of KOPIO activities in September. Michael Marx as KOPIO PM continues to focus efforts on developing a fully resource loaded schedule for KOPIO and on developing an RSVP TEAM proposal designated KLM. Dean Schamberger is working on development of photo detector readout and establishing a laboratory for APD and FEE work. He is managing resources for the combined FEE/DAQ/trigger efforts. Paolo Rumeiro is working on kinematic fitting of multiphoton events for both signal and background studies. Ilektra-atha Christidi spends much of her time on E949, but is also contributing to KOPIO efforts on DAQ measuring data throughput bandwidth, and on analysis of the micro bunch beam test data from this Spring.

Virginia Tech M. Blecher

(a) GEANT simulations reported to collaboration (M Blecher)
  (1) mu decay rates in the KOPIO detector
  (2) self veto rates
  (3) veto rates from other K in a beam burst
(b) hardware studies for D4 vetos (A Hatzikoutelis, N Graham, M Blecher)
A report is being prepared.
We use 5 x 15 x 50 cm^3 scintillator slabs obtained from Y Kudenko's Russian supplier and 1 inch Burle Tubes and bases, model 83112-511. The slabs have 19 grooves running in the long direction for 1 mm WSF. We have calibrated the tubes for single photoelectrons (spe) with random triggers and with a light (green) emitting diode. The two methods are in agreement. Using a triple coincidence cosmic ray trigger we have monitored the light output for cosmic rays passing through the slab for 4 different fibers:
a) Bicron single and multi clad b) Kuraray single and multiclad. We also determine the time resolution from the sum of the times from both ends of the slab relative to the trigger. In the first case the fibers were simply placed in the grooves and held with a layer of saran wrap. The single clad Kuraray fibers gave the most light. Next several types of fibers were held in the grooves with optical grease. This provided more light out. Finally we are preparing to glue the Kuraray fibers in the grooves with optical epoxy. We also investigated using APDs as a readout. However, for HV below Grigor's limit we weren't able to see any light from the cosmic rays.

Yale activity M. Zeller

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- R&D on a low pressure proportional chamber that will possibly act as a CPV directly in the beam.
- Beam studies to increase beam flux by small adjustments to collimators, and determination of the mechanical limits of apertures that will define the horizontal extent of the beam.

[4] MECO Experiment (WBS 1.3)

Project Manager’s Overview

Over the last month there have been two developments of particular importance. The first is that FY04 funding has finally reached UCI. Work is now underway to distribute these funds as quickly as possible to restart R&D work that had largely ground to a halt for lack of money. To this end, we have signed SOWs with MIT for magnet work and Houston for Tracker hardware and electronics development. We expect contracts to be in place in October for these efforts. We have a signed SOW in the BNL contracts office for evaluation now, and we are hopeful that it too will allow for a contract to be signed in the next month or two. A first version of the SOW with Boston University for the Trigger and DAQ design effort has been reviewed. A much revised version is expected shortly.

We have had a first round of discussions with LBL for their effort to redesign the BaBar Elefant readout chip for MECO use. As we are only able to support a fraction of one FTE, we have some time to sort this out. We have not yet begun to negotiate SOWs for either the Heat and Radiation Shield design effort or the RF Modulated Magnet design work. In both cases we must identify suitable vendors before proceeding. Discussions of magnet contracting support with LLNL have been postponed until after the upcoming magnet review in October.

The second significant development has been the announced departure of the MECO Project Manager in a period of 3-6 months time. Additional details are available upon request. The collaboration's Executive Committee has begun the search for a suitable replacement.

Below are brief updates from each of the major MECO subsystems.

WBS 1.3.1 Extinction

We have reorganized the WBS structure to include only MECO supported extinction activities in a new RSVP level 3 subsystem. Items previously appeared in the proton beamline. Items now included are the RFMM with all controls, 2 external extinction monitors, any physical elements associated with a secondary beam channel for extinction studies, and a possible new monitor of extinction in the AGS itself. Not included are modifications to the AGS to improve extinction, Lambertson magnets to separate physically filled and unfilled buckets in the proton beam, and design of the proton beam optics (one goal of which is to help improve extinction).

We have continued with studies of the extinction monitor that looks at particles coming from the muon production target. We have continued with the design of the RFMM and have purchased some components of a prototype RFMM and drive circuit, and have placed orders for other items.

WBS 1.3.2 Production Target and Heat Shield

In July, engineering effort on the heat shield was halted when R&D funding was exhausted and the lead AGS engineer on the effort departed the lab for another position. Just prior to his departure, he put together a brief report summarizing the thermal studies of the proposed water-cooling system and the proposed mechanism for installing the shield within the warm bore of the PS cryostat. This needs to be incorporated into to the reference design for the system. Further engineering development is planned over the next year via a modest invest ($18k) with an outside vendor. We have begun discussions with a group at Dubna about possibly taking on the design of the heat shield. No new work has been done on the production target, but UCI plans to continue testing water-cooled prototypes using induction heating to optimize heat removal with the minimum possible thickness of material (coolant and jacket) outside the target rod to maximize the pion yield from the system.

WBS 1.3.3 Superconducting Solenoids

During the month of September 2004, the magnet group has dedicated their time to updating all aspects of the magnet technical, cost and schedule database in preparation for the upcoming magnet review in October. Risk minimization studies have not yet been initiated with industry as we are awaiting formal receipt of a contract for the current period's work, expected imminently.

WBS 1.3.4 Muon Beamline

MECO Note 130 was published: *MECO Detector Solenoid Vacuum System* by D. Weiss, W. Leonhardt, W. Meng, D. Phillips, P. Yamin (BNL), P. Nemethy (NYU), and J. Popp (UCI). Another MECO Note, MECO *Detector Solenoid Vacuum Requirements* by W. Morse and A. McUmber (BNL) is about to be sent in. The latter evaluates the design requirement of 10^{-4} Torr for the DS vacuum. It concludes that physics running at 10^{-3} Torr is expected to be acceptable; however, we want to measure detector rates vs. vacuum pressure to verify the calculations, and it would be nice to have a point at 10^{-4} Torr. The MECO Note 130 DS vacuum pump system has a pumping speed of 6062 l/s (air) for the nominal three CF-10 cryo pumps. The pumping speeds for other gases are also given in Note 130.

The collimator physics design has been stable since MECO Note 100 by V. Tumakov. Calculations are continuing on the TS shielding, both internal to the TS warm bore under normal operations and external shielding between the proton beam pipe and the TS cryostat to protect the coils in the event of a beam fault condition. An initial specification for shielding in both regions has been provided.

In the past month engineering studies have continued on a low duty cycle part time basis, on MECO Detector Solenoid interface issues. The work concentrated on warm-bore attachments to the cylinder wall of the cryostat and on the segmentation and installation of the boron-loaded polyethylene neutron shielding material in the warm bore. In the next month several interface reports will be completed

For the muon stopping rate monitor, a 40 cc germanium crystal with 3 cm depth is expected to capture full-energy events for the 356 keV X ray of muonic aluminum with an efficiency of about 50%. For the 1021 keV X ray of muonic titanium this efficiency drops to 33%. The combination of high, full-energy event efficiency and excellent peak resolution (2.2 keV) assures that the muonic atom formation process is well determined. A number of vendors supply complete spectrometer systems. Three prominent firms are Princeton Gamma Tech (PGT), Perkin-Elmer (Ortec) and Canberra. At the present time we have a quotation from PGT, and have requested the same from the other two firms. Since quotes place the price of this spectrometer system in the range of $50k we have not been able to move forward in obtaining this detector at this point.

WBS 1.3.5 Straw Tracker

Progress in the tracker has proceeded in three directions. We have obtained a few straws having 15 μm wall thickness. These are composed of two overwound layers of Cu clad 7 μm Kapton. The straws have been tested for mechanical and electrical properties. They are able to hold >14 psi and have sufficiently low leak rates in a vacuum to permit their use in the transverse tracker. Of the 25 straws we have, 5 are found to lack electrical continuity from one end of the straw to the other. This is due to sparking during vacuum deposition on the foil. This issue was discussed with the manufacturer who states better quality control can solve the problem. We have now ordered a sufficient quantity of straws to make a full scale prototype plane for the transverse tracker.

We continue to prepare a test of our longitudinal prototype tracker with 3.5 MeV protons. The prototype has been installed and operated in a vacuum chamber. A scintillation monitor is installed to calibrate the proton rates to the integrated current in a Faraday cup. We have had noise problems induced by the turbo pump, but these now appear to be solved. The vacuum chamber with prototype should be installed in the beamline next week.

We continue to develop the prototype readout electronics. A noise problem in the digitizing chip has been identified as inherent to the original design and will be fixed in the upgraded version. Discussions with LBL were initiated as to when the redesign engineering could begin.

WBS 1.3.6 Calorimeter

In the last month we have received two samples of the larger (3.75 × 3.75 × 14 cm) Lead Tungstate crystals and have started setting up for head to head comparisons of these to the previous standard smaller (3 × 3 × 14 cm) crystals for light collection, light yield, and resolution. Both sizes are the Russian manufactured crystals. We have also received nine (3 × 3 × 14 cm) crystals made by Shanghai High Tech. Corp. for comparison.

We have continued to interact with the manufacturer about APD HV discharge problems. We implemented improvements in the preamp design in new circuitry to be prototyped. A meeting held at NYU, of the BU and NYU groups on calorimeter electronics and trigger was productive in crystallizing issues.

WBS 1.3.7 Cosmic Ray Shield

In September we confirmed in cosmic ray studies that our scintillator design for the CR Active Shield delivers an average of 34 photoelectrons in a CR triggered configuration. The test scintillator, 1 x 10 x 25 cm of BC404 wrapped in Tyvek, was read out by three (3) embedded BCF-92 WS fibers (1.5mm) coupled to a Hamamatsu R7600U-M4 PMT.

After 5 months of seeking licenses from DOE for extruding coated and grooved scintillator material, the licenses are finally in hand. ITASCA PLASTICS can now proceed with fabrication of the die. Scintillator bars remain 4.5 m in length.

We have switched our preliminary selection of a PMT to the Hamamatsu R7600U-M16 PMT. This allows us to assign the 3 WSFs of each unit bar to a single cell of the 16 channels. Hamamatsu has shown that much better cathode uniformity is achieved with the M16.

Studies with and without a mu shield surrounding an R7600U-M4 in an 80 gauss field confirmed the need for a shield in locations 25 cm from the Return Yoke. A design and cost estimate for mu metal magnetic shields has been worked out in discussions with Magnetic Shield Corp. This simple design of an open-ended, mu metal box of 3.1 x 3.1 x 9 cm, will serve as a manifold that houses the 3.0 x 3.0 x 5 cm PMT assembly and supports an alignment block that precisely couples each set of 3 optical fibers to a specific cathode cell.

WBS 1.3.8 Trigger and Data Acquisition

A first pass at the separation of design work in the DAQ chain and how it interfaces with the tracker and calorimeter has been completed. The study of how the DAQ interfaces with other subsystems such as extinction monitor, muon veto shield, slow controls etc is in progress. A modification of the draft SOW for BU to account for the reduced amount of 2004 funds available to begin work on the trigger processor will be completed shortly. We have chosen to separate the offline analysis, previously a part of this level 3 WBS (1.3.9), into a separate level 3 item that incorporates the simulation and software organization efforts for the experiment as well. We have chosen to include all of the data quality monitoring (magnet currents, chamber voltages, etc.) into this level 3 WBS as it must be written to tape at intervals along with the data.

WBS 1.3.9 Simulations and Offline Analysis

This WBS has newly been added to the MECO structure this month. We are in the process of recruiting a suitable candidate to lead this effort. The job consists of coordinating both the Monte Carlo simulations and offline analysis coding efforts for the experiment. At the moment, we have physics simulation efforts underway at UCI, NYU, and BNL. Houston has been simulating the tracking detector electronics as well. Although these efforts have been loosely coordinated up to this point, we do not have a single set of software tools that are accepted for use throughout the collaboration. We also have many more studies to conduct than individuals working to complete them. Making this effort a level 3 WBS in the project will raise its profile to an appropriate level within the collaboration and allow us to integrate detector simulations into the project schedule.

WBS 1.3.10 Installation and Integration

Following suggestions from several people within MECO as well as outside it, we have chosen to separate out the installation tasks from the individual detector systems and collect them here as a new level 3 WBS under the direction of the MECO Chief Mechanical Engineer.

WBS 1.3.11 MECO Project Office

Searches continue for qualified candidates for both the Chief Mechanical Engineer and the Chief Electrical Engineer positions. The subsystem managers are currently working on updating the WBS Dictionary. We will be introducing a version of a comprehensive MECO Microsoft Project file in which we will develop both the schedules and the costs for later inclusion in Access, if needed. We are, of course, also heavily engaged in preparations for the first subsystem review, the magnets, on October 10-12.

NYU, BNL, and Houston have begun planning educational outreach. Testing has begun of the first component, remote web based lectures by MECO scientists to teachers. Lead teachers at each of these three institutions have been selected and have begun working on the program. In test runs so far we have not found existing web tools that are reliable and flexible enough for what we wish to do.

[4] AGS Upgrade Project (WBS 1.4)

Our weekly meetings aimed at cost and schedule issues for the RSVP AGS Infrastructure WBS continued through September. Meeting presentations (as well as other information relevant to the AGS Infrastructure WBS) can be found at http://server.c-ad.bnl.gov/esfd/RSVP/RSVP_AGS_WBS.htm.

The C-AD group are still in the process of re-doing cost estimates for RSVP and are working toward the generation of resource loaded schedules. Work in September was, for the most part, a continuation of the work started in August aimed toward identifying all work to be done for each AGS infrastructure WBS element and determining how interfaces with the experiments are going to he handled. This work is on-going. No funds for this activity have been provided so the work it is being done at a low level.

The AGS Infrastructure cost estimate (fully burdened costs without contingency) totaled $29M at the end of September. The total now includes a rough estimate for AGS/Booster shield caps. RSVP AGS beam development costs (estimated at ~$30M) are now identified but need to be revisited. Several items - RSVP Project Office, specialized AGS beam collimators, MECO magnet, refrigeration and experimental area infrastructure, K0PI0 experimental area, counting house, fast electronics hut etc have yet to be added in. The cost for upgrading obsolete AGS power supply controls was examined in more detail in late September, resulting in a significant decrease in costs. This cost savings (>$1M) is not yet reflected in the total costs.

The C-AD group are working toward an external review of the AGS WBS, set for 4-5 November 2004. As of this writing a charge has not been delivered and therefore no agenda set. In order for us to properly prepare for the review, we need the charge at least a month in advance (today!). Our plan is to complete development of costs using Excel spreadsheets and to make a first pass at an overall technically driven schedule. Fully developed Project files and Access databases will not be available for the review.

The C-AD Project Office funds ($210K) have been promised from the RSVP Project Office to support base-lining efforts. Statements of Work have been formalized for MECO ($141K) and K0PI0 ($600K) sub-contract work but no funds have materialized as of the end of September. The funding level for authorized for the AGS project office and MECO support is not adequate. We plan to request supplemental FY2005 funds for these efforts.